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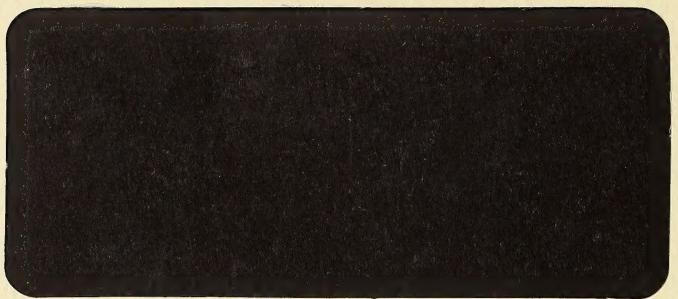
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BOW/CANMORE CORRIDOR

ENVIRONMENTAL ISSUES ANALYSIS

- 1990 -



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- 1990 -

**Prepared by: Cottonwood Consultants Ltd.
Calgary, AB**

**For: Alberta Tourism
Edmonton, AB**



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A recent flurry of tourism development proposals in the Bow/Cannmore Corridor has given cause for Alberta Tourism to develop a Tourism Development Framework. The framework is intended to complement the Inegrated Resource Planning process and its expected to provide more specific information and recommendations for tourism development by the public sector, private sector and non-profit organizations.

There are numerous natural and cultural features that have been identified in the Corridor. This has raised concerns regarding the potential impacts of tourism development on the area's environment. Within the process of developing the Tourism Development Framework, Alberta Tourism recognizes the need to include consideration of environmental issues which are likely to arise as a consequence of development. By conducting an "environmental issues analysis" early in the planning process, it is intended that provision can be made for the incorporation of appropriate environmental management in the planning process. It is suggested that planning and development issues relating to tourism be addressed to tourism operators and issues of environmental impact be addressed to environmentalists.

The specific purpose of this study is to define and rank the environmental concentrations and issues related to tourism development in the Bow/Cannmore Corridor and to make some broad suggestions for ways of reducing potential impacts and conflicts.

Some researchers believe that tourism contributes to environmental degradation while others believe that proper planning and management has much unrealized potential for environmental protection, negative impacts do occur. Greater awareness of natural and cultural environments and economic justification for environmental protection from the "ecotourism" have been positive benefits of tourism. According to modern concepts

8. inappropriate development on flood plains.
7. impacts on in-stream flows and environmentally significant areas from water withdrawls.
6. expansion or replacement of the sewage treatment facilities.
5. contamination of ground and surface water from chemicals used on golf courses.

Watersheds:

4. direct loss or fragmentation of native plant habitats.
3. continued loss or disturbance of critical plant and wildlife habitats, including habitat for rare or endangered species.
2. impacts on streams from construction activities and movement of chemicals into streams from golf courses.
1. direct loss of wildlife habitats, especially further disruption of elk migration corridors between summer and winter ranges.

Wildlife and Fisheries Habitats and Environmentally Significant Areas:

In approximate order of importance, the major issues related to proposed tourism developments in the Bow/Cammore Corridor are:

Major Issues

As part of ongoing development planning and research, identify key fisheries exist to identify, protect and interpret environmental opportunities and resources. Reclamation and stabilization of past disturbances such as old mine workings could also enhance the local environment.

Opportunities

Scoping of Environmental Issues and Opportunities

14. significant expansion of tourism developments would put an extra burden on landfills facilities in the region.

Solid wastes:

13. the cumulative impact of proposed tourism developments combined with existing and former developments could create a much more significant disruption of landscape aesthetics than already exists.

Aesthetic Impacts:

12. competition for backcountry recreation opportunities.

Land Use Conflicts:

11. air quality deterioration related to smoke from wood-burning fireplaces being trapped by inversions.

Air Quality:

10. development of unstable or steep slopes that could lead to erosion and slope failure.

Terrain and Soil:

9. continued degradation of archaeological and historic resources.

Cultural Resources:

EXECUTIVE SUMMARY

A recent flurry of tourism development proposals in the Bow/Canmore Corridor has given cause for Alberta Tourism to develop a Tourism Development Framework. The Framework is intended to complement the Integrated Resource Planning process and is expected to provide more specific information and recommendations for tourism decision-making by the public sector, private sector and non-profit organizations.

There are numerous natural and cultural features that have been identified in the Corridor. This has raised concerns regarding the potential impacts of tourism development on the area's environment. Within the process of devising the Tourism Development Framework, Alberta Tourism recognizes the need to include consideration of environmental issues which are likely to arise as a consequence of development. By conducting an "environmental issues analysis" early in the planning process, it is intended that provision can be made for the incorporation of appropriate environmental considerations into the planning and decision making that is to follow.

The specific purpose of this study is to define and rank the environmental concerns and issues related to tourism development in the Bow/Canmore Corridor and to make some broad suggestions for ways of reducing potential impacts and conflicts.

Some researchers believe that tourism contributes to environmental degradation while others believe that, with proper planning and management, tourism can enhance the environment. While tourism has much unrealized potential for environmental protection, negative impacts do occur. Greater awareness of natural and cultural environments and economic justification for the improved protection and management of fish, wildlife and cultural resources from "ecotourism" have been positive benefits of tourism.

Cultural Resources:

9. continued degradation of archeological and historic resources.

Terrain and Soil:

10. development of unstable or steep slopes that could lead to erosion and slope failure.

Air Quality:

11. air quality deterioration related to smoke from wood-burning fireplaces being trapped by inversions.

Land Use Conflicts:

12. competition for backcountry recreation opportunities.

Aesthetic Impacts:

13. the cumulative impact of proposed tourism developments combined with existing and former developments could create a much more significant disruption of landscape aesthetics than already exists.

Solid Wastes:

14. significant expansion of tourism developments would put an extra burden on landfill facilities in the region.

Scoping of Environmental Issues and Opportunities

Opportunities

As part of ongoing development planning and research, significant opportunities exist to identify, protect and interpret key fisheries and wildlife resources, environmentally significant areas and cultural sites. Reclamation and stabilization of past disturbances such as old mine workings could also enhance the local environment.

Major Issues

In approximate order of importance, the major issues related to proposed tourism developments in the Bow/Canmore Corridor are:

Wildlife and Fisheries Habitats and Environmentally Significant Areas:

1. *direct loss of wildlife habitats, especially further disruption of elk migration corridors between summer and winter ranges.*
2. *impacts on streams from construction activities and movement of chemicals into streams from golf courses.*
3. *continued loss or disturbance of critical plant and wildlife habitats, including habitat for rare or endangered species.*
4. *direct loss or fragmentation of native plant habitats.*

Watersheds:

5. *contamination of ground and surface water from chemicals used on golf courses.*
6. *expansion or replacement of the sewage treatment facilities.*
7. *impacts on in-stream flows and environmentally significant areas from water withdrawals.*
8. *inappropriate development on flood plains.*

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Mitigation Strategies

Some of these impacts are mitigatable while some are not and, for others, there is insufficient research data to indicate how successful mitigation could be. The major issues that appear difficult to resolve or where research data is insufficient include:

1. *the impact of tourism developments on critical wildlife migration corridors.*
2. *the impact of golf courses on water quality.*

Other issues have a high probability for successful mitigation through traditional and innovative land and water use controls. Major potential mitigation strategies include:

1. *Identify, protect and interpret environmentally significant areas and important cultural resources.*
2. *Screen all projects for potential impacts and conduct formal Environmental Impact Assessments for major developments (or groups or classes of developments) prior to development.*
3. *Adhere to specific guidelines for protecting the environment outlined in plans of the M.D. of Bighorn.*
4. *Conduct additional environmental research.*
5. *Develop facilities in the most capable and least sensitive land systems.*
6. *Refine environmental standards.*
7. *Upgrade and develop sewage treatment facilities as required.*
8. *Coordinate planning and management agencies at municipal, provincial and federal levels.*

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1. TOURISM DEVELOPMENT FRAMEWORK PROCESS

1.1 Introduction

Change is a natural, inevitable consequence of tourism and recreation use. The question is: how much change is acceptable? The environment is not just a constraint, it is a resource; it is not just a problem, it is also an opportunity (UNEP 1979). It is important for society to define clearly what it is that we want as much as that which we do not want. Identifying environmental issues can assist in planning by more clearly defining what the various development trade-offs are likely to be.

The process of environmental analysis pertaining to tourism development should be:

1. define potential concerns and issues, including cumulative impacts
2. define range of tourism and conservation opportunities desired
3. select indicators or prime areas of concern
4. inventory cultural sites and natural resources
5. define minimum standards for resource
6. delineate nodes for different tourism opportunities
7. identify mitigation for developments
8. monitoring

The purpose of this study is to define a wide range of environmental concerns and issues related to proposed tourism developments in the Bow/Canmore Corridor, to rank them, and to make some broad suggestions for reducing potential impacts.

A discussion of the literature related to tourism and the environment is found in Appendices 1 and 2. Appendix 3 outlines the National Audubon Society's Tourism Code of Conduct.

1.2 Bow/Canmore Tourism Development Framework

There is increasing pressure for major tourism facility development in the Bow/Canmore Corridor. With its location adjacent Banff National Park and Kananaskis Country and the interest of local authorities and the province in the Corridor as a growing tourism destination area, Alberta Tourism is preparing a Tourism Development Framework in conjunction with

Fisheries

- to enhance and maintain fisheries habitat and viable populations of wild fish stocks

Water

- to maintain the water quality of streams and the Bow River
- to prevent vegetation changes that could cause extreme fluctuations in streamflow

Terrain

- to prevent or minimize soil erosion occurrences associated with land use activities
- to ensure that reclamation guidelines and standards are adhered to
- to undertake reclamation projects on vacant public land where unacceptable environmental conditions exist

Wildlife

- to maintain current elk and bighorn sheep populations
- to protect bald eagle, golden eagle and osprey nesting sites
- to maintain a diversity of habitat for bird populations
- to maintain long-toed salamander populations and protect their habitat
- to minimize impacts on wildlife populations from development and recreational activities
- to maintain bow hunting

Tourism

- to provide the opportunity for development of the Bow Corridor as a major four season tourism and recreation area
- to increase viewing and interpretation opportunities for non-consumptive use of wildlife resources
- to maintain and enhance the scenic natural resource features
- to allow for and minimize the environmental impacts of limited summer and winter off-road recreational motorized vehicle use

1.4 M.D. of Bighorn Regulations

The M.D. of Bighorn General Municipal Plan allows resort developments if environmentally safeguarded, and recreation developments if compatible with the natural environment. One of several area structure plans, the South Corridor Structure Plan provides a sequence for development, gives a base density for recreational development, and allows for 1/4-section splitting of lands.

Specific policies in the General Municipal Plan which are relevant to this study can be summarized as follows:

other government agencies. The Bow Corridor Integrated Resource Plan is being used as a major reference for the development of this framework.

The intent of the Tourism Development Framework is to identify tourism opportunities that are environmentally and economically sound. It will provide a framework for decisions and development guidelines for future major tourism facilities. The framework is expected to be used by the private sector, local authorities and the provincial government for making decisions related to tourism developments.

The Tourism Development Framework will attempt to:

1. provide information for proposed and potential tourism developments on private and public lands in the Corridor;
2. assess tourism market demands, resource capability, development requirements including utilities, environmental issues, visual impacts, socioeconomic impacts, and cumulative impacts of potential tourism developments;
3. involve the general public, interest groups, tourism developers, Community Tourism Action Committees, Town of Canmore, M.D. of Bighorn, Calgary Regional Planning Commission and several provincial government departments; and
4. provide a framework for tourism decision-makers in their implementation of identified opportunities.

Public involvement in the Integrated Resource Planning and Tourism Development Framework process will be jointly coordinated. Round-table discussions will be scheduled with various interest groups, minerals industry and tourism developers. A full public review will also be held, probably in the early summer of 1990 (Steber 1990).

1.3 Bow Corridor Local Integrated Resource Plan Objectives

With respect to tourism and environmental protection, the draft Bow Corridor Local Integrated Resource Plan has several stated objectives which are relevant to this study. These can be summarized as follows:

Historical and Ecological Resources

- to preserve historical resources and selected unique or representative ecosystems or features
- to manage historical and ecological resources for scientific, educational and interpretive purposes

8. development on floodplains will not be permitted without adequate mitigative measures.
9. development shall be prohibited in critical wildlife areas.
10. developers are required to gather specific biophysical information.

The area structure plan allows for a base level of development per quarter section of up to 40 campsites, 40 beds in recreational lodges and hostels or 8 country residential parcels in country residential subdivisions.

1. any development proposed must show, through a comprehensive analysis, that the land is developable with minimal negative impacts to the natural environment.
2. consideration for the inclusion of ESA's in the General Municipal Plan as protected areas.
3. potentially polluting development adjacent water courses will not be permitted without adequate mitigation.
4. measures should be taken to protect forests from possible fire hazards.
5. development should be concentrated to focus impacts and conserve surrounding natural areas.
6. a program for reclaiming old mine sites, pits and quarries should be instituted.
7. the impacts of increased industrial, commercial, residential and recreational use should be monitored and managed to conserve the surrounding natural environment.
8. the M.D. will assess the local environmental significance of the land and will ensure that any approvals minimize negative impacts.
9. development in the vicinity of ESA's will be permitted only if site specific measures to adequately protect the significant area are incorporated into the development.

The M.D. of Bighorn South Corridor Area Structure Plan includes a number of specific development policies that would be applicable to tourism developments:

1. development areas should be contiguous to maximize open space.
2. residential lots should be clustered.
3. buffer zones shall be established between developments and critical wildlife areas.
4. development setbacks from the tops of escarpments are required.
5. development will not be permitted on lands that may be subject to subsidence due to past mining activities.
6. unstable slopes shall not be developed.
7. development will be discouraged on marsh deposits and active or inactive drainage channels on alluvial fans.

B. Surficial Geology

The Bow Valley underwent multiple glaciations. Surficial materials include undifferentiated colluvium over bedrock, and glaciofluvial sands and gravels, coarse till and fluvial fans along lower valley slopes.

The benchlands are developed on heterogeneous, very variable surficial materials. The Bow River occupies a major glacially modified valley that now contains a complex stratigraphy of glacial and post-glacial sediments. The valley fill reaches local thicknesses of several hundred meters and is generally coarse material of glaciofluvial or glacial origin with lesser amounts of finer glaciolacustrine sediment.

C. Hydrology

The Bow River cuts through the middle of the Corridor occupying only a small portion of its large floodplain. Tributary streams include Canmore Creek, Cougar Creek, Policeman Creek, Stewart Creek, Three Sisters Creek, Pigeon Creek, Heart Creek, Jura Creek, Exshaw Creek and Grotto Creek.

A complex surface-subsurface water system operates in the Bow Valley. There are numerous minor tributary streams and scattered mineral and organic wetlands. The surficial deposits are characterized by high porosity, permeability and transmissivity. There are high volumes and seasonal variations in surface and groundwater flow rates. A possibility exists of major subsurface karst spring contributions to groundwater flow and there is a possible, but unlikely, presence of restricted groundwater flow within the valley.

D. Unique Geological Features

Unique geological features include the hoodoos and Rat's-nest Cave near Canmore. A series of glaciofluvial terraces northwest of Canmore, the braided river flats along the Bow River, and the canyons of Jura Creek, Grotto Canyon and Exshaw Creek have also been classified as significant (Lamoureux et al 1983).

2.1.3 Biological Features

A. Vegetation

The vegetation of the Bow/Canmore Corridor is typical of disjunct northern portions of the Montane Natural Region and there is Subalpine and Alpine vegetation at higher elevations outside the proposed development area.

At lower elevations, there are forests of Douglas fir, white spruce, lodgepole pine and aspen while there are lodgepole pine and spruce-fir in subalpine zones. Low shrubbery, fescue grassland and krummholz spruce-fir occur in the alpine. Riparian communities of willow, balsam poplar and back channel wetlands occur along the Bow River.

2. OVERVIEW OF ENVIRONMENTAL AND CULTURAL RESOURCES

2.1 Natural Resources

The natural resources of the Bow/Canmore Corridor are described by Wallis and Wershler (1972), Borneuf (1976), Ozoray and Barnes (1977), Bow Valley Naturalists (1974), Van Waas (1976), O'Leary (1988) and Alberta Forestry, Lands and Wildlife (1990).

2.1.1 Climate

The climate is representative principally of the Montane Natural Region, with some Subalpine and Alpine climates at higher elevations outside the proposed development area. Chinook winds keep portions of the area snow-free in winter and temperature inversions sometimes occur.

The following table provides selected climatic parameters for the Montane, Subalpine and Alpine Ecoregions.

Ecoregion	May to August		Dec. to Feb.		Oct. to April Precipitation (mm)
	Temp. (°C)	Precip. (mm)	Temp. (°C)	Chinook Days	
Montane	12.1	262	- 7.5	20	300
Subalpine	10.5	316	- 9.0	15	400
Alpine	6.5	360	-14.0	<5	400

2.1.2 Physical Features

The study area lies in the Front Ranges of the Rocky Mountains and includes a small portion of the Rosebud Plain of the Western Alberta Plains along the eastern edge. Elevations range from 1300 m near Seebe to 2600 m above sea level on top of the Three Sisters.

A. Bedrock Geology

The predominant rock types are Upper Paleozoic limestone and dolomite and minor Lower Paleozoic sandstone, shales, siltstone and coal. Bedrock is extensively exposed on mountains on both sides of the Corridor.

C. Environmentally Significant Areas (Map 1)

The following is a listing and description of the major environmentally significant areas identified on Map 1:

Area 1. Wind Ridge

- critical winter bighorn sheep and summer and winter elk range
- one of the finest winter ranges for bighorn sheep in the Canadian Rockies (V. Geist, pers. comm.)

Area 2. East Canmore Flats (Canmore Creek/Bill Griffiths Creek)

- provincially significant brown and brook trout spawning channels
- critical elk habitat
- long-toed salamander habitat
- bald eagle and osprey habitat at Gap Lake and along the Bow River

Area 3. Policeman Creek

- important brook and brown trout spawning channels

Area 4. Mt. Charles Stewart and Benchlands

- important bighorn sheep winter range
- interesting glaciofluvial terraces and hoodoo formations
- valley grasslands

Area 5. Grotto Mountain

- important bighorn sheep range

Area 6. Pigeon Mountain

- important fall and winter elk and winter bighorn sheep range on Pigeon Mountain
- mature Douglas fir forests in the proposed Pigeon Mountain Natural Area lie at the northern edge of this area

Area 7. Lac des Arcs

- significant waterfowl staging
- habitat for bald eagles and ospreys
- geological feature of interest; created by the coalescing of two alluvial fans

Area 8. Exshaw Creek and Exshaw Mountain

- important bighorn sheep winter range

There are important mineral springs (e.g. Yamnuska, Many Springs) and associated rare flora. Rare flora is also potentially associated with major limestone outcrops. Mature Douglas fir forests on Pigeon Mountain have been identified as significant.

B. Wildlife

The wildlife along the valley floor is typical of disjunct northern portions of the Montane Natural Region. At higher elevations, species typical of the Subalpine and Alpine Natural Regions are present.

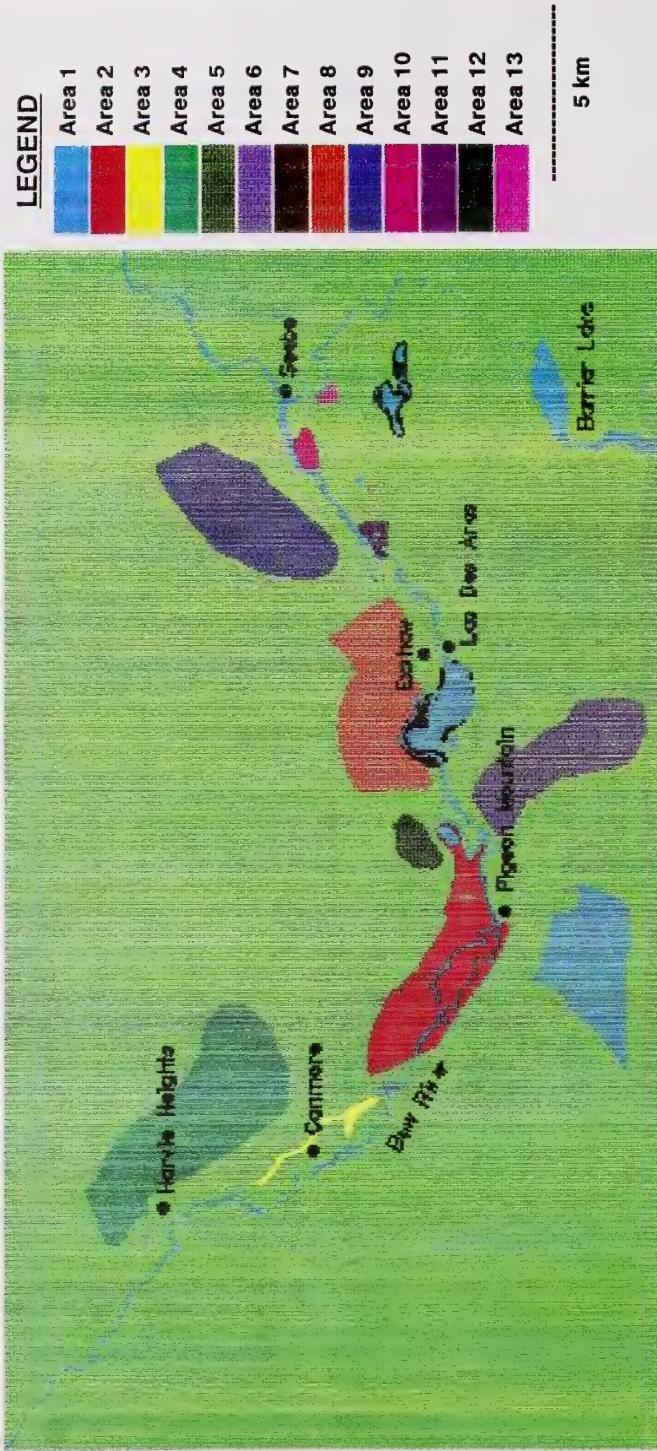
There are important elk and bighorn sheep winter ranges (e.g. Upper West Wind valley, Wind Ridge, Benchlands, Mt. Charles Stewart, Bow Valley Park, Grotto Mountain, Mt. Laurie). About 300 bighorn sheep winter within the Corridor on five to six key winter ranges. In summer they move to higher elevations, as far north as the South Ghost and as far south as Mount Allan. The largest population (about 120) of elk in the Corridor winter in the Pigeon Mountain/Wind Ridge area but there may be up to 150 in the Harvie Heights/Canmore area and 70-80 at Bow Valley Provincial Park. There is also some use of Bow Valley Provincial Park as an elk movement corridor and summer range.

The Bow River and some of its tributaries contain important fisheries including mountain whitefish and brook and brown trout populations. Major spawning areas are present in side channels and tributaries such as Bill Griffiths and Policeman Creeks.

There are diverse breeding bird habitats associated with significant mineral springs and wetlands (e.g. Yamnuska, Many Springs, Highway 1X beaver ponds, Chilver Lake wetlands). Waterfowl and bird of prey habitats (bald eagle, osprey) occur in the vicinity of Lac des Arcs (Beak Associates 1986). Rare long-toed salamanders occur sparingly in ponds along the Bow Valley.

BOW/CANMORE CORRIDOR ENVIRONMENTAL ISSUES ANALYSIS

- MAP 1: ENVIRONMENTALLY SIGNIFICANT AREAS -



Area 9. Yamnuska

- diverse breeding bird habitats
- calcareous springs
- rare flora including a white form of the yellow-lady's slipper

Area 10. Chinaman Pits

- long-toed salamander habitat in borrow pits dug by Chinese labourers for the Canadian Pacific Railway near the turn of the century

Area 11. Many Springs

- diverse breeding bird habitats
- provincially significant calcareous springs
- rare flora including a white form of the yellow-lady's slipper

Area 12. Chilver Lake Wetlands

- diverse breeding bird habitats
- some waterfowl production

Area 13. Highway 1X Beaver Ponds (Bow Valley Provincial Park)

- diverse breeding bird habitats

2.2 Cultural Resources

The Bow/Canmore Corridor contains a variety of Native and Non-Native cultural resources that vary in their sensitivity to development. They are described in more detail in Lamoureux et al (1983).

2.2.1 Prehistoric (Native Cultural Resources)

The Bow/Canmore Corridor was both a major route to the transcontinental passes between the Kootenai Valley and the Eastern Slopes as well as a significant settlement area for Native Peoples for at least the last 10,500 years. Resource inventories and assessments to date have been targeted towards specific resource categories or areas.

A. Campsites and Bison Kill Sites

Campsites are associated with five land forms in the valley:

Alluvial Fans: The toes of the low angle alluvial fans along the valley were favoured locales on both the north and south side for campsites, evidence of which have been found from just below the surface to depths of 4 meters below the surface, and dated to 10,000 years in age. Bison kills have also been found in these locales.

Moraine-Esker Sediment Traps: Ice block depressions and other enclosed basins in the remnants of the moraine & esker systems along the valley walls have been used as campsites and kills. Sites dating in excess of 8000 years are known. These sediment traps are relatively rare and small in area.

Lateral Moraine and Kame Terrace Remnants: Kame terrace, lateral moraine edges and bedrock ridges overlooking the valley were used as campsites. Archaeological remains are generally shallowly buried below the surface. Sometimes localized sediment traps occur.

Floodplains: Lower floodplains were used for camps and kills, most of which are deeply buried below the surface and date in the last 5000 years. In most cases the sediments of the lower floodplains are not exposed by erosion, and the extent of use of these areas is not well known. A favoured spot for camps of Native people and White explorers was the flats below the Hoodoos, both north and south of Highway 1.

Kame/Esker Complex: The extensive kame/eskerine complex at the mouth of the Bow Valley on the north and south sides of the river is an area of Native settlements. Bison kills occur in sloughs and springs, and campsites at many locales, often near the small lakes/ponds.

B. Rock Art

Two rock art sites are known: Grassi Lake and Grotto Creek and another has recently been reported above Grassi Lake. Other rock art sites in remote isolated locales may well exist, as many were painted during vision quests and other sacred activities. The rock art is done in red ochre and gradually fades through time. The sites are well known and easily accessible to hikers.

C. Stone Quarries

Local silicified siltstones and cherts were used for the manufacture of stone tools. These materials were obtained both from gravels and glacial tills as well as from bedrock outcrop. Quarries have been identified in Banff National Park, and they should exist also downstream.

D. Stone Structures

Native peoples constructed cairns and other stone structures in the mountains, generally on high isolated areas or peaks for vision questing and other spiritual purposes. These sites have been recorded both north and south of the Bow/Canmore Corridor, and should exist within the Corridor.

E. Rock Shelters

Rock shelters are very rare in the area. The only identified one with evidence of Native use is at Grassi Lake. Others may exist that were

2.2.3 Significant Cultural Resource Sites & Sensitive Areas (Map 2)

The following is a listing of the significant cultural resources identified to date. These are referenced by number (#) on Map 2:

#	Site Type	Landform Type
1	Buried Campsite	Alluvial Fan/River Terrace
2	Surface Campsite	Kame/Esker Complex
3	Cairns	Kame/Esker Complex
4	Buried Campsite	River Terrace
5	Surface Campsite	Kame/Esker Complex
6	Buried Campsite	River Terrace
7	Bison Kill?	Kame/Esker Complex
8	Surface Campsite	Kame/Esker Complex
9	Buried Campsite?	River Terrace
10	Historic Site-Foundations	
11	Historic Site-Canmore NWMP Post	
12	Historic Site-Old Town Canmore	
13	Historic Site-Georgetown	
14	Surface Campsite	Kame/Esker Complex
15	Surface Campsite	Kame/Esker Complex
16	Cairns	Kame/Esker Complex
17	Buried Campsite	Alluvial Fan
18	Historic Site-East Gates	
	Rocky Mountain National Park	
19	Historic Site-Old Town Kananaskis	
20	Surface Campsite	River Terrace
21	Historic Site-Old Town of Exshaw	
22	Historic Site-Butcherts Lime Kilns	
23	Buried Campsite	River Terrace
24	Surface Campsite	Kame/Esker Complex
25	Surface Campsite	Alluvial Fan
26	Buried Campsite	Lacustrine/Alluvial Fan
27	Historic Site-Medicine Lodge	
28	Historic Site-Cairn goes with lodge	
29	Historic Site-Cairn goes with lodge	
30	Historic Site-Cairn goes with lodge	
31	Historic Site-Cairn & Stone Feature goes with lodge	
32	Surface Campsite	Kame/Esker Complex
33	Surface Campsite	Kame/Esker Complex
34	Buried Campsite	River Terrace
35	Buried Campsite	Alluvial Fan/Terrace
36	Buried Campsite	Alluvial Fan/Terrace
37	Buried Campsite	Alluvial Fan/Terrace
38	Stone Feature	Kame/Esker Complex
39	Surface Campsite	Kame/Esker Complex
40	Bison Kill	Alluvial Fan/Terrace
41	Bison Kill	Alluvial Fan/Terrace
42	Cairn	Kame/Esker Complex
43	Pictographs	Grotto Canyon
44	Buried Campsite	Lacustrine

used as camps or for spiritual purposes (as may have been parts of the cave systems). In addition, rock shelters and caves often contain important paleoecological records of animal bones, preserved plants, pollen and fecal material, accumulated through their use by pack rats, raptors and carnivores.

F. Trails

A network of trails existed in the Corridor, including the Old Bow Trail, and others that provided access to the passes. Segments of the trails still exist along the north side of the valley and are sensitive to development activities. These trail segments also provide an opportunity to develop a historic recreational trail network within the valley.

2.2.2 Historic (Non-native) Resources

The Bow/Canmore Corridor contains a rich and diversified mix of historic sites relating to the settlement and resource use of the Corridor over the last 120 years. These include the archaeological and architectural remains of former towns and mines as well as standing buildings of architectural and historic interest in the town of Canmore and elsewhere in the Corridor.

A. Townsites

Four former/existing townsites are present: Kananaskis, Exshaw, Canmore and Georgetown.

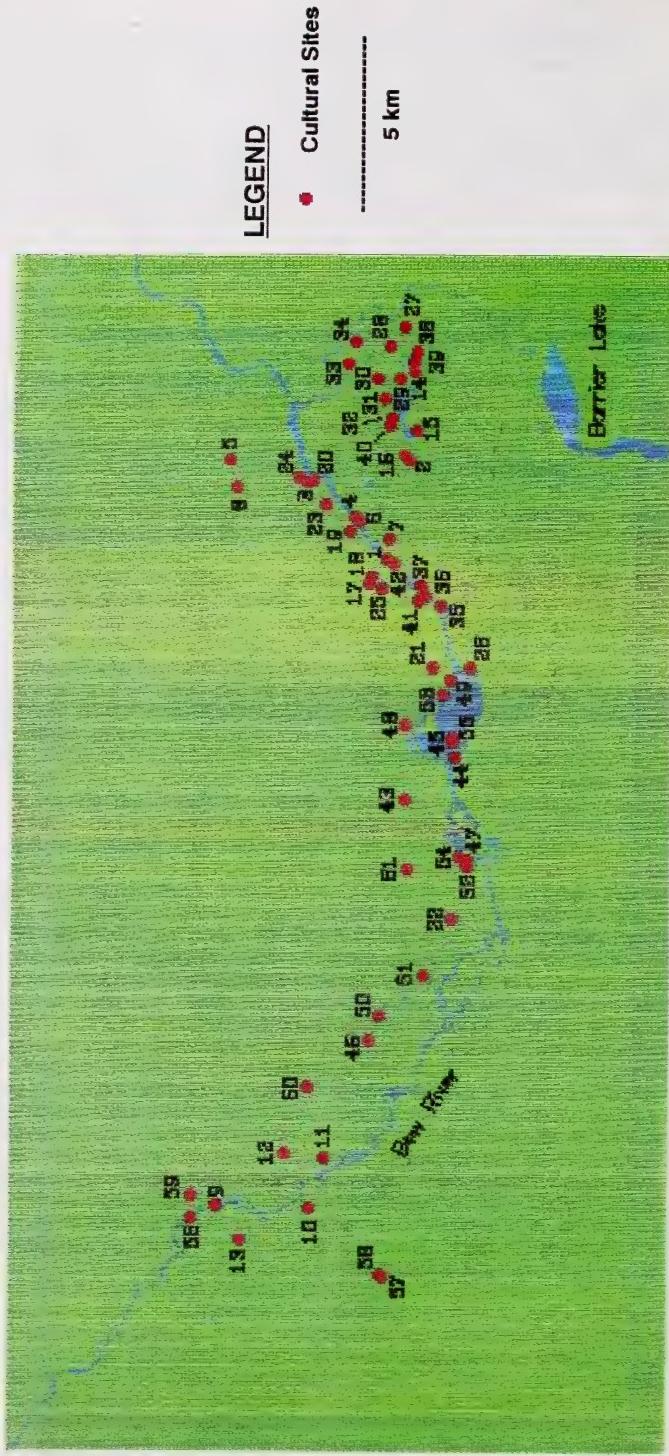
B. Other Sites

Other sites include the remains of the Georgetown mine workings, the Butchert Lime Kilns, Kananaskis Lime Kilns, and the site of the East Gates of Rocky Mountain National Park as well as various historic interest spots.

BOW/CANMORE CORRIDOR

ENVIRONMENTAL ISSUES ANALYSIS

- MAP 2: SIGNIFICANT CULTURAL SITES -



45	Buried Campsite	Lacustrine
46	Buried Campsite	Alluvial Fan/Terrace
48	Buried Campsite	Pitted Moraine
49	Buried Campsite	Alluvial Fan/Terrace
50	Surface Campsite	Ice contact Terrace
51	Historic Site-Depression	
	Relief Camp?	
52	Buried Campsite	River Terrace
53	Historic Structure	
54	Historic Foundation	
55	Buried Campsite	Lacustrine
56	Buried Campsite	River Terrace
57	Grassi Lake Pictographs	
58	Grassi Lake Rockshelter	
59	Surface Campsite	Ice Contact Terrace
60	Surface Campsite	Ice Contact Terrace
61	Rat's Nest Cave	

3. OVERVIEW OF PROPOSED TOURISM DEVELOPMENTS

The following are the known tourism development proposals and associated facilities in the Corridor which are displayed on Map 3. All information regarding the listed proposals is tentative. It is current as of late April 1990 and is subject to partial or complete change.

3.1 Alpine Resort Haven (Kan-Can)

- time share chalets -- up to 75 units, 10 initially
- 75 RV sites
- located at old Pigeon Mountain ski area on Crown land
- individual pump out sewage facility for each chalet
- use of groundwater

3.2 Canmore Alpine Resort (formerly Banff National Resort)

- four season resort with luxury 500 room hotel and up to 27 hole golf course
- residential/resort housing
- located in Canmore Benchlands
- includes 194 hectares (480 acres) of public land; \$5-10 million in government assistance
- linkage to Canmore water and sewer system

3.3 Canmore Banff Park Boundary RV Park

- this area was included at the commencement of this study, however, it has now been dropped from consideration as the lease application has been cancelled

3.4 Four Season Resort -- Seebe (Trouth)

- 600 RV stalls, golf driving range
- 50 units of fixed roof accommodation
- located north of Kananaskis Guest Ranch near Seebe
- applied for 73 hectares (180 acres) of public land

3.5 Georgetown Resort

- 500 room hotel with 45 hole golf course
- interpretive centre
- located west of Canmore Nordic Centre on south side of Bow River
- 200 hectares (494 acres) of public land in Kananaskis Country
- requires new Bow River bridge and C.N.P. crossing

BOW/CANMORE CORRIDOR

ENVIRONMENTAL ISSUES ANALYSIS

- MAP 3: EXISTING AND POTENTIAL TOURISM DEVELOPMENTS.

LEGEND

- Canmore Nordic Centre (Existing)
- Bow Valley Provincial Park
- Mt. Lady McDonald Cabin House
- Mountain Meadow Golf Course
- Three Sisters Golf Resorts
- River Bend Golf Course
- Alpine resort/Haven
- Seabird Ranch
- Kananaskis Seasonal Campground
- Kananaskis Guard Ranch
- Kananaskis Golf Course
- NEAT Thaw Valley Ranch
- Tim Horton's Children's Camp
- Four Season Resort "Kananakis"
- Canmore Banff Park Boundary RV Park
- Georgetown Development Inc.
- RV Campground Barrier Lake
- Banff National Park
- Private Land
- BOUNDARY Study Area

Municipal District of Bighorn Town of Canmore

10 Km



3.6 Kananaskis Guest Ranch Golf Resort

- addition to existing facility of an 18 hole golf course, campgrounds, RV park and fixed roof accommodations
- located at junction of Highway 1A and 1X northwest of Seebe
- applying for 130 hectares (320 acres) of public land
- septic disposal field or pump out tank for sewage
- Bow River water with some wells for irrigation

3.7 Mt. Lady McDonald Tea House

- helicopter access to tea house and lookout
- located on Mt. Lady McDonald, north side of Bow/Canmore Corridor
- 4 hectares (10 acres) of public land

3.8 Mountain Meadow Golf Course

- 18 hole golf course
- located east of Nordic Centre, partially in Canmore
- applied for 93 hectares (230 acres) of public land
- would likely connect to Canmore System for sewer

3.9 NEV Thomson RV Park (Seebe)

- 110 site full service year round equestrian destination campground
- 60 fixed roof accommodation units
- south of Bow Valley Provincial Park near Seebe and Rafter 6
- 38 hectares (95 acres) of public land in Phase I, 80-100 hectares (200-250 acres) for future expansion
- sewage disposal by septic fields, including trailer dumping station available to the general public

3.10 River's Bend Golf Course

- 18 hole golf course, hospitality centre, resort centre, serviced campground, condominiums and clubhouse
- located at Deadman's Flats
- applied for 30 hectares (74 acres) of public land; with additional development on lands owned by the M.D. of Bighorn

3.11 Three Sisters Golf Resorts

- three 18 hole golf courses utilizing, in part, old coal mining areas
- requires diversion of peak flows in Three Sisters and Stewart Creek and pumping from groundwater wells and the Bow River
- provision for storm water retention
- roadway from Spray Lakes to Pigeon Mountain interchange
- hotels and a variety of residential units, RV park, campgrounds and modular home park
- connection to Canmore for sewer and water utilities in initial phases of developments
- servicing of Wind Valley phase yet to be determined

ENVIRONMENTAL ISSUES AND OPPORTUNITIES MATRIX

	A	B	C	D	E	F	G	H	I	J	K	O
Wildlife												
*Protect and view wildlife	2	2	2	2	2	3	2	?	2	2	1	2
*Reclaim old mine sites	3	3	3	3	3	3	3	?	3	3	1	3
Disruption/loss of habitat	M	H	H	H	M	M	M	H	H	H	H	
Bear conflicts	M	M	M	M	M	L	M	M	M	M	M	
<u>Fisheries</u>												
*Protect and view fish spawning	3	3	3	3	2	3	3	3	3	2	2	
Siltation of fish habitat	L	L	L	M	L	L	L	M	M	M	M	
Contamination of fish habitat	L	H	L	H	H	L	H	L	H	H	H	
<u>Environmentally Significant Areas</u>												
*Protect and view features	3	2	2	2	2	3	3	3	2	2	1	2
Disruption/loss of critical habitat	L	M	M	M	M	L	L	M	M	H	M	
Loss of rare wildlife or plants	L	M	L	M	L	L	L	M	M	M	M	
<u>Vegetation</u>												
*Reclaim old mine sites	3	3	3	3	3	3	3	3	3	1	3	
Disruption/loss of vegetation	M	H	M	H	M	M	M	H	H	H	H	
Increased risk of fire	L	L	L	L	L	L	L	L	L	L	L	
Spread of exotic plants	L	M	M	L	L	L	L	L	L	L	L	
<u>Watershed</u>												
Contamination from golf courses	L	H	L	H	L	H	L	H	H			
Excessive water withdrawals	L	?	L	L	L	?	L	?	?	?		
Upgrading sewage treatment	L	M	L	M	M	M	L	M	M	M		
Floodplain development	L	L	L	M	L	L	L	M	M	M		
<u>Cultural Resources</u>												
*Protect/interpret important sites	3	2	2	3	3	2	3	2	2	3	3	2
Damage to cultural resources	L	M	M	L	M	L	M	M	L	M	L	
<u>Terrain and Soil Issues</u>												
Steep or unstable slopes	L	M	M	L	L	M	L	M	L	L	L	
Erosion	L	M	M	L	L	M	L	M	L	L	L	
Damage to geological features	L	M	L	L	L	L	L	L	L	L	L	
<u>Land Use Conflicts</u>												
Backcountry recreation conflicts	L	L	M	L	L	L	L	M	L	L	M	
Fishing access restrictions	L	L	L	M	L	L	M	M	L	M	L	
<u>Aesthetic Impacts</u>												
Litter	L	L	L	L	L	L	L	L	L	L	L	
Noise	L	L	L	L	H	L	L	L	L	L	L	
Construction material storage	L	M	L	M	L	L	M	L	M	L	M	
Housing of construction workers	L	M	L	M	L	L	M	L	M	L	M	
<u>Other Considerations</u>												
Wood smoke pollution	L	M	L	L	L	L	L	L	L	M	L	
Blowing dust during construction	L	L	L	L	L	L	L	L	L	L	L	
Pollution from automobile exhaust	L	L	L	L	L	L	L	L	L	L	L	
Solid Waste Disposal	L	M	L	M	M	L	L	L	M	L	M	
Abandoned Mines	L	L	L	L	L	L	L	L	L	M	L	
Maintaining Ecological Processes	L	M	M	M	M	L	L	M	M	M	M	

*** Opportunities**

1 - High

2 - Moderate

3 - Low

Issues

H - High: Significant Negative Effects/Mitigation Potential Low or Unknown

M - Medium: Significant Negative Effects/Mitigation Potential High

L - Low: Few or No Significant Negative Effects

? - Unknown - Insufficient Research Data

- A - Alpine Resort Haven
- B - Canmore Alpine Resort (formerly Banff National Resort)
- C - Canmore Banff Park Boundary RV Park
- D - Four Season Resort, Seesbe
- E - Georgetown Resort
- F - Kananaskis Guest Ranch Golf Resort
- G - Mt. Lady McDonald Tea House
- H - Mountain Meadow Golf Course
- I - NEV Thomson RV Park
- J - River's Bend Golf Course
- K - Three Sisters Golf Resorts
- O - Overall Rating (All Developments)

4. SCOPING OF ENVIRONMENTAL ISSUES AND OPPORTUNITIES

The following is a scoping of the environmental issues and opportunities associated with proposed tourism developments in the Bow/Canmore Corridor. This is based on a survey of the literature, government file material and interviews with government personnel and members of environmental interest groups.

Where possible, there is a discussion not only of the major problems associated with the various issues but also of any significant opportunities for environmental protection and research that may arise as a result of proposed developments. It should be remembered that many opportunities currently exist but proposed tourism developments may provide the impetus for protection and enhancement programs and research by a variety of individuals and agencies.

The issues are arranged in approximate order of importance with wildlife and water quality issues being the most significant and the most difficult to resolve with any degree of confidence. A summary is provided in the "Environmental Issues and Opportunities Matrix".

4.1 Wildlife Issues

4.1.1 Significant Opportunities

1. *Tourism in the Corridor presents an opportunity to identify and protect wildlife habitats, including critical elk habitat, and to allow for viewing and interpretation.*
2. *Reclamation of old mine sites could improve ungulate habitat.*

4.1.2 Major Problems

The principal problems of tourism development in the Corridor with respect to wildlife would appear to be the direct loss of wildlife habitats and indirect losses through control, displacement, and harassment, especially further disruption of elk migration corridors between summer and winter ranges.

4.1.3 Discussion

There has been a tendency for developments to encroach on more restricted grassland and edge habitats that are important for ungulates, particularly elk.

The direct loss or fragmentation of habitat and blockage of travel routes for large ungulates like elk is likely to be one of the major environmental issues in the Corridor where there has already been a considerable disruption of wildlife activities through the cumulative

impacts of a variety of land uses. The sensitivity of elk to human disturbance has resulted in abandonment of portions of the Corridor. Herds appear to be blocked from movement through the Canmore district. Other developments such as the Three Sisters Golf Resorts could impair movements between important wintering and summering areas leading to further population declines.

There are a significant number of road kills along the Trans-Canada Highway. In 1986, 27 elk were killed, mostly in the area east of Canmore to Highway 40. In combination with hunting, this loss may be more than the population can sustain (Nette and Jorgenson 1989). The cumulative impact of road kills combined with the effects of proposed tourism developments in migration corridors could severely limit elk populations.

Additional stress and harassment of ungulates could result in further movement into marginal areas. Increased vehicle access and traffic, especially the new road encircling the benchland in the proposed Three Sisters development, could increase harassment, poaching and road kills.

Some improvement of ungulate habitat could arise from appropriate reclamation of old mining operations and other disturbed sites. Projects which replace or enhance wildlife habitats could mitigate some direct losses.

4.1.4 Other Considerations

Other wildlife issues include:

1. the potential disruption of long-toed salamander breeding sites through water extractions for other uses or impact on breeding ponds due to chemical contamination from golf courses
2. an increased potential for bear conflicts, including problems arising from waste handling and human intrusions into grizzly bear habitat in Wind Valley
3. potential disturbance and loss of important waterfowl staging areas at Lac Des Arcs from water-based recreation or through measures to control dust

4.3.1 Environmentally Significant Opportunities

4.3 Environmentally Significant Areas

The proposed tourism developments present an opportunity to identify, preserve and interpret the environmentally significant natural resources of the Bow/Cannmore Corridor.

of the Bow/Cannmore Corridor.

4.3.2 Major Problems

The principal problem related to proposed tourism developments and environmental significance areas is the continued loss or disturbance of habitat or impairment of water quality.

A variety of existing developments have already impacted fish habitat and movements of wildlife between critical ranges (see Wildlife section).

Deterioration in water quality could affect significant springs and breaching habitats for rare species like long-toed salamanders which are very locally distributed in the mountains of Alberta.

Recreational developments adjacent wetlands such as those at Chilcotin Lake have already disturbed edge habitats and additional developments could reduce breeding bird diversity and populations.

The cumulative effect of quarrying operations at Yamnuska combined with proposed reclamation development along Highway 1A could severely impact the quality of the unique spring and wetland habitats at the base of Mt. Laurier.

4.3.4 Other Considerations

An Environmental Study is ongoing in the M.D. of Bighorn and will provide additional insights into significant resources of the Bow/Cannmore Corridor.

4.2 Fisheries

4.2.1 Significant Opportunities

Tourism in the Corridor presents an opportunity to protect fish habitat and to allow for viewing and interpretation of fish spawning.

4.2.2 Major Problems

The principal potential problems of tourism developments in the Corridor with respect to fisheries are impacts related to construction activities and movement of chemicals (fertilizers, herbicides, pesticides, fungicides) into streams from golf courses.

4.2.3 Discussion

There has already been some impairment of fish habitat through siltation in the town of Canmore. Further siltation of spawning streams and increased fluctuations in stream temperature and velocity could arise due to road and other construction and through removal of natural vegetation cover for tourism developments.

About 40 golf courses are currently proposed in southwestern Alberta. The magnitude of developments in Calgary's watershed and their cumulative impacts are apparently of major concern to city administrators and to groups like Trout Unlimited.

The question of golf courses and contamination of water supplies is an area of growing concern. There is very little data on this problem but, given the high permeability of the surface materials over much of the Corridor and the extensive use of chemicals by golf courses, this has the potential of becoming a significant issue.

4.2.4 Other Considerations

Pollution of streams could also occur through inadequately treated wastewater, storm sewer runoff, and chemical spills.

Overfishing and deterioration and erosion of streambanks by trampling from fishing and boating activities could also be problems.

4.5.1 Major Problems

4.5 Watershed Issues

1. Potential contamination of ground and surface water from golf courses is a major potential problem associated with tourism expansion throughout the Gorridor.
2. Water withdrawals could impact in-stream flows and environmentally significant areas.
3. Major tourism growth would require expansion or replacement of the existing sewage and water treatment facilities.

A. Water Quality

4.5.2 Discussion

4. Development on flood plains.

- The principal concern for water is quality. This has less to do with impacts from agriculture and more to do with impacts from golf courses. The administration of the City of Calgary and groups like Trout Unlimited are nervous about the degree of development in Calgary's courses. The administration of the City of Calgary and groups like Trout Unlimited are nervous about the degree of development in Calgary's watersheds. Golf courses use a variety of chemicals inputs including fertilizers, herbicides, pesticides and fungicides. The excessive porosity of much of the surface materials could result in contaminants moving downward into the water table and into adjacent streams. This is a looming issue that may not be easily resolved.

Groundwater is used extensively through the valley. The effects of groundwater contamination will be felt by those with shallow wells. Increased human waste could result in increased organic pollution if accompanied by using a mechanical rotating biological contactor (RBC). Current treatment processes that was installed in 1985. It is reliable but sewage discharge is chlorinated. There is an infiltration problem that takes up much of the plant's capacity -- ground water comes into the sewer system in summer months. The plant has a capacity of 1.2 million gallons per day. Sewage discharge in January was .9 million gallons per day and has been up to 1.35 million gallons per day in summer. Apparently, the discharge is still of reasonable quality even during periods when it is beyond its design capacity. There were some problems with sewage lift stations this past winter.

The Cammore sewage plant appears to be operating close to capacity at times. If there is a major tourist expansion then it is possible that tertiary treatment would be required. At a minimum, the current chlorine treatment may be replaced by UV disinfection or dechlorination required.

4.4 Vegetation

The incidence of fire and spread of exotic plant materials would increase with proposed tourism developments but this is expected to be a minor problem.

Trampling of native vegetation will also result in a loss of species and a change in species composition.

No comprehensive survey of rare, threatened and endangered plants has been done in the Corridor but there is the potential for loss of habitat for rare species, particularly in wetlands and grassland areas.

4.4.1 Significant Opportunities

The proposed tourism development opportunities to enhance vegetation through reclamations such as old mine workings and to protect and interpret a variety of natural vegetation.

The tendency for developments in the Corridor has been to occupy the open natural grassland areas and edge habitats, resulting in a loss of some of the most restricted habitat types in the valley. These areas are also important for ungulates.

Old mine workings and other disturbances are prime sites for reclamation work that could enhance environmental quality in the valley. This is one way in which tourism development could potentially have spin-off benefits in ungluate management.

4.4.2 Major Problems

The principal problem related to proposed tourism developments and vegetation is the direct loss or fragmentation of native plant habitats.

4.4.3 Discussion

The tendency for developments in the Corridor has been to occupy the open natural grassland areas and edge habitats, resulting in a loss of some of the most restricted habitat types in the valley. These areas are also important for ungulates.

Old mine workings and to protect and interpret a variety of natural vegetation.

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Tourism in the Corridor presents an opportunity to protect fish habitat and to allow for viewing and interpretation of fish spawning.

4.2.2 Major Problems

The principal potential problems of tourism developments in the Corridor with respect to fisheries are impacts related to construction activities and movement of chemicals (fertilizers, herbicides, pesticides, fungicides) into streams from golf courses.

4.2.3 Discussion

There has already been some impairment of fish habitat through silting in the town of Kamloops. Further silting of spawning streams due to road and other construction and temperature removal of natural vegetation increased fluctuations in stream temperature and velocity could arise due to golf courses currently proposed in south western Alberta.

About 40 golf courses are currently proposed in south western Alberta. The magnitude of developments in Calgary's watershed and their cumulative impacts are apparently of major concern to city administrators and to groups like Trout Unlimited.

The question of golf courses and contamination of water supplies is an area of growing concern. There is very little data on this problem but, given the high permeability of the surface materials over much of the area, the potential of becoming a significant issue.

4.2.4 Other Considerations

Pollution of streams could also occur through inadequate treatment of wastewater, storm sewer runoff, and chemical spills.

Overfishing and deterioration and erosion of streambanks by trampling from fishing and boating activities could also be problems.

4.3 Environmentally Significant Areas

4.3.1 Significant Opportunities

The proposed tourism developments present an opportunity to identify, preserve and interpret the environmentally significant natural resources of the Bow/Canmore Corridor.

4.3.2 Major Problems

The principal problem related to proposed tourism developments and environmentally significant areas is the continued loss or disturbance of critical plant and wildlife habitats, including habitat for rare or endangered species.

4.3.3 Discussion

Additional developments may impact directly or indirectly on areas of environmental significance or sensitivity through destruction of habitat or impairment of water quality.

A variety of existing developments have already impaired fish habitat and movements of wildlife between critical ranges (see wildlife section).

Deterioration in water quality could affect significant springs and breeding habitats for rare species like long-toed salamanders which are very locally distributed in the mountains of Alberta.

Recreational developments adjacent wetlands such as those at Chilver Lake have already disturbed edge habitats and additional developments could reduce breeding bird diversity and populations.

The cumulative effect of quarrying operations at Yamnuska combined with proposed recreation developments along Highway 1A could severely impair the quality of the unique spring and wetland habitats at the base of Mt. Laurie.

4.3.4 Other Considerations

An Environmentally Significant Areas study is ongoing in the M.D. of Bighorn and will provide additional insights into significant resources of the Bow/Canmore Corridor.

4.4 Vegetation

4.4.1 Significant Opportunities

The proposed tourism developments present opportunities to enhance vegetation through reclamation of disturbances such as old mine workings and to protect and interpret a variety of natural vegetation.

4.4.2 Major Problems

The principal problem related to proposed tourism developments and vegetation is the direct loss or fragmentation of native plant habitats.

4.4.3 Discussion

The tendency for developments in the Corridor has been to occupy the open natural grassland areas and edge habitats, resulting in a loss of some of the most restricted habitat types in the valley. These areas are also important for ungulates.

Old mine workings and other disturbances are prime sites for reclamation work that could enhance environmental quality in the valley. This is one way in which tourism development could potentially have spin-off benefits in ungulate management.

4.4.4 Other Considerations

No comprehensive survey of rare, threatened and endangered plants has been done in the Corridor but there is the potential for loss of habitat for rare species, particularly in wetlands and grassland areas.

Trampling of native vegetation will also result in a loss of species and a change in species composition.

The incidence of fire and spread of exotic plant materials would increase with proposed tourism developments but this is expected to be a minor problem.

4.5 Watershed Issues

4.5.1 Major Problems

1. Potential contamination of ground and surface water from golf courses is a major potential problem associated with tourism expansion throughout the Corridor.
2. Water withdrawals could impact in-stream flows and environmentally significant areas.
3. Major tourism growth would require expansion or replacement of the existing sewage and water treatment facilities.
4. Development on flood plains.

4.5.2 Discussion

A. Water Quality

The principal concern for water is quality. This has less to do with impacts from accommodations and more to do with impacts from golf courses. The administration of the City of Calgary and groups like Trout Unlimited are nervous about the degree of development in Calgary's watershed. Golf courses use a variety of chemical inputs including fertilizers, herbicides, pesticides and fungicides. The excessive porosity of much of the surficial materials could result in contaminants moving downward into the water table and into adjacent streams. This is a looming issue that may not be easily resolved.

Groundwater is used extensively through the valley. The effects of groundwater contamination will be first felt by those with shallow wells.

Increased human waste could result in increased organic pollution if accommodation outstrips the provision of treatment facilities. Canmore is currently using a mechanical Rotating Biological Contactor (RBC) sewage treatment process that was installed in 1985. It is reliable but discharge is chlorinated. There is an infiltration problem that takes up much of the plant's capacity -- ground water comes into the sewer system in summer months. The plant has a capacity of 1.2 million gallons per day. Sewage discharge in January was .9 million gallons per day and has been up to 1.35 million gallons per day in summer. Apparently, the discharge is still of reasonable quality even during periods when it is beyond its design capacity. There were some problems with sewage lift stations this past winter.

The Canmore sewage plant appears to be operating close to capacity at times. If there is a major tourism expansion then it is possible that tertiary treatment would be required. At a minimum, the current chlorine treatment may be replaced by UV disinfection or dechlorination required.

Canmore's water system has been designed for 8500 people at an average consumption of 100 gallons per person per day.

The temporary housing of construction workers presents problems with respect to waste disposal.

Contamination from leaking underground gas station storage tanks and from other commercial facilities could also create water quality problems.

B. Water Quantity

The increased surface water demand for municipal needs and golf course irrigation could result in less water for other uses, e.g. riparian flow and in-stream fisheries needs. The increased demand for ground water could result in impacts to environmentally sensitive areas of mineral springs (e.g. Yamnuska, Many Springs) that support rare plants. Overpumping effects include decline in surface water levels and draining of water out of the unsaturated zone (Anderson 1987).

C. Flood Plain Development

There is concern about further development on flood plains along the Bow River and major creeks. Fluvial fans and floodplains are potential flood areas.

A 1929 flood destroyed a flood wall at Exshaw and deposited a large gravel bar in the Bow River, altering its flow. The last serious flood in Exshaw was 1931 (Gardner 1981).

At Canmore, early floods occurred in 1879, 1884, 1897, 1904 and 1923. The 1923 flood has a maximum instantaneous discharge of 14,100 cfs at Banff. Concern for flooding was heightened by the 1974 flood in Canmore. Part of Canmore was inundated and 90% of the basements in town were flooded.

If water storage reservoirs are built in-stream and are not designed for major flood events, this could have serious consequences for downstream developments. The concern about flooding along Exshaw Creek was significant enough for Canada Cement Lafarge to commission a flood study (Northwest Hydraulic Consultants 1979).

Storage of hazardous materials on the floodplain could be a problem resulting in chemical pollution during a major flood event.

Modification of flood events through diking, channelization and landscaping can result in changed stream morphology.

4.6 Cultural Resource Issues

4.6.1 Significant Opportunities

The proposed tourism developments present an opportunity to identify, preserve and interpret the significant cultural resources of the Bow/Canmore Corridor.

4.6.2 Major Problems

The major cultural resources issue with respect to tourism development is the continued degradation of archeological and historic resources. There is no regional or municipal management plan for the cultural sites of the Bow/Canmore Corridor, and as a result over the past 15 years there has been a substantial loss and degradation of the Corridor's Native and Non-Native sites.

4.6.3 Discussion

The loss of cultural resources has occurred through a variety of activities that have not been subject to review or regulation by Alberta Culture and Multiculturalism, the agency charged with the responsibility of managing the resources at the Provincial level.

The cultural sites of the Bow/Canmore Corridor encompass some 10,000 years of Native and Non-Native settlement and resource use. They are integral components of the Corridor's heritage and are non renewable and fragile. Losses are occurring as a result of both the processes of wind and water erosion and human activity. Human activities that impact these resources range from recreational use of the area, that impact sites by foot, horse and vehicle traffic and through the wide range of development and resource extraction activities that result in the alteration of land surfaces, removal of subsurface deposits and renovation or removal of standing buildings.

The Native and Non-Native cultural sites vary in their sensitivity to development impacts. Some lie in areas that are little used by recreationists as well as being outside potential development areas. Some Native campsites are deeply buried and are not impacted by normal surface land use activities or shallow alteration of the lands. Others lie in areas of high existing or potential recreation or economic development, are on or shallowly buried below the surface, and are easily lost. Non-Native architectural remains of past settlements and resource use, e.g. lime kilns and coal mines, are particularly sensitive to loss, as well as purposeful or accidental vandalism.

The cultural sites also vary in their local, regional and provincial significance. Some of the Native campsites are small ephemeral sites and of little value while others are very large and significant sites. Some are very ancient and rare or unique, and of provincial significance. Most of the Non-Native sites such as Old Town Canmore and Old Town

Kananaskis and the Butchert Lime Kilns are rare and unique sites of Provincial Significance.

A. Prehistoric (Native) Sites

- Campsites & Bison Kill Sites

Alluvial Fans, Rutter's (1972) Landform 15, are most sensitive to development impacts including gravel extraction. Kame/Esker Complex (Rutter's Landform 4) camps are shallowly buried below the surface of the ground, and are very sensitive to development impacts. Moraine-Ice Contact Sediment Traps (Rutter's Landforms 5 & 6) are relatively rare, small in area and sensitive, to development impacts, including gravel extraction.

Lateral Moraine and Kame Terraces (Rutter's Landforms 5 & 6) are very sensitive to development impacts, as the locales often coincide with preferred view planes looking out across the valley. Bedrock ridges were also used for similar purposes. River Floodplains and Lacustrine landforms (Rutter's Landforms 7 & 16) are sensitive to development.

- Rock Art

Some loss has occurred through lighting fires in the rockshelter at Grassi Lake that has rock art in it, as well as scribbling graffiti on the panels. This activity will continue and increase as developments grow and recreationists use the area. Major damage could occur to the panels.

- Stone Structures

Stone structures are very visible and easily disturbed and disrupted by recreationists as well as economic development activities (construction of helicopter landing pads, seismic drilling sites) associated with use of the higher slopes and peaks.

- Trails

Segments of trails, like the Old Bow Trail, still exist along the north side of the valley and are sensitive to development activities.

B. Historic (Non-native) Sites

- Townsites

Kananaskis, Old Town Canmore and Georgetown are significant sites and sensitive to development impacts as well as vandalism by recreationists and other users. None of the sites are protected or designated. Detailed studies have not been done.

4.7 Terrain and Soil Issues

4.7.1 Major Problems

The major potential problem with respect to terrain and soil is development of unstable or steep slopes that could lead to erosion.

4.7.2 Discussion

Poorly-drained, saturated slopes, particularly in subalpine zones but also in some montane areas on north-facing slopes, could easily slump if disturbed. Roadworks across steep slopes could create significant terrain impact.

4.7.3 Other Considerations

Flood protection works could create significant terrain impact.

Soils tend to be thin and easily disturbed. There could be increased compaction of soils and subsequent erosion from trampling of native cover.

There could be some degradation of unique geological features (e.g. fossil beds, hoodoos).

4.8 Air Quality Issues

4.8.1 Major Problems

The principal problem related to air quality and proposed tourism developments is expected to be inversions trapping smoke from wood-burning fireplaces.

4.8.2 Discussion

The wood smoke problem appears to be growing in severity worldwide and has recently attracted a fair amount of scientific interest. The problem is likely to be most severe on calm days when there are temperature inversions in the valley when cold air is trapped below a layer of warm air.

4.8.3 Other Considerations

Blowing dust, especially during construction phases, could add to ambient fugitive dust from the Canada Cement Lafarge and Steel Brothers plants as well as the blowing dust problem from Lac des Arcs. These problems are expected to be minor. Unlike the major problems in the past, the dust from quarrying and processing operations is considered fairly well controlled and meets provincial regulations. Most current problems are related to meteorological events -- at a certain temperature and

humidity, one cement plant stack creates a haze related to ammonia in the shale combining with water vapour.

Exhaust from automobiles and trucks could add to the hydrocarbons and other air pollutants.

4.9 Land Use Conflicts

4.9.1 Major Problems

Increased visitation from the proposed tourism developments could result in competition for backcountry recreation opportunities.

4.9.2 Discussion

There could be loss or impairment of wildland recreation opportunities, including conflicts between helicopter tours and other users. Developments could also restrict access to backcountry areas and important fisheries and increase the potential for conflict between bow-hunting and wildlife viewing.

4.10 Aesthetic Impacts

4.10.1 Major Problems

The cumulative impact of proposed tourism developments combined with former coal mining, existing limestone mining, and development on Pigeon Mountain could result in a much more significant disruption of landscape aesthetics than already exists.

4.10.2 Discussion

Existing and former mining operations have already created numerous scars on the landscape in the Bow/Canmore Corridor. Expansion of tourism developments in the viewshed could add significantly to this problem, possibly impairing views on both sides of the valley. There is some potential for tourism developments to recontour and reshape past disturbances into more pleasing viewscapes.

4.10.3 Other Considerations

Other aesthetic impacts would include increases in litter, noise from traffic and construction, and problems associated with storage of construction materials and temporary housing of construction workers.

4.11 Other Issues

4.11.1 Solid Waste Disposal

Significant expansion of tourism developments would put an extra burden on landfills in the Corridor.

Improperly handled solid wastes could increase bear conflicts.

4.11.2 Abandoned Mines

There is a potential hazard posed by abandoned mines (M.D. of Bighorn 1987). It appears to be very difficult to accurately locate former mining operations and to establish which areas may be subject to collapse. Based on experience in England, subsidence can occur for at least 100 years after mining operations cease.

4.11.3 Maintenance of Ecological Processes

The ability to deal with natural succession and maintenance of the ecological balance has already been impaired. This could be further reduced since options for activities like prescribed burning may no longer exist in the presence of major tourism developments.

4.11.4 Socio-Economic Impacts

Additional study is required to detail the full range of potentially substantial socio-economic impacts.

5. MITIGATION STRATEGIES FOR BOW/CANMORE TOURISM DEVELOPMENT

5.1 Environmental Planning and Assessment

5.1.1 Principal Strategies

1. *Identify environmentally significant areas and important cultural resources.*
2. *Screen all projects for potential impacts and conduct formal Environmental Impact Assessments for major developments (or groups or classes of developments) prior to development.*
3. *Adhere to specific guidelines for protecting the environment outlined in plans of the M.D. of Bighorn.*

5.1.2 Discussion

An environmentally significant areas study is currently underway in the M.D. of Bighorn. While this study will identify the most significant resources, detailed site evaluations for significant cultural and natural resources will still be required on proposed development sites.

The federal and provincial governments have instituted or are in the process of instituting environmental assessment reviews for all projects that could have significant environmental impacts. The goals of environmental assessments should be to minimize pollution, protect wildlife and ecologically important features and preserve the natural environment and scarce resources.

The integrated resource plan provides a general framework for resource protection. The M.D. of Bighorn's South Corridor Area Structure Plan and General Municipal Plan provide some specific guidelines for the identification, protection and planning of tourism and other developments.

5.1.3 Other Strategies

Tourism developments should be clustered to minimize disturbance of natural landscapes related to the specific tourism developments and any associated servicing requirements (e.g. sewer and water, power lines). Artificial attractions (i.e. facilities like waterslides and golf courses which do not interpret or help protect the natural environment) should not be developed in areas of high sensitivity.

The existing environmental standards and guidelines should be refined as more knowledge of resources and their sensitivity becomes available.

5.2 Resource Protection Needs

5.2.1 Principal Strategies

All environmentally significant areas, including critical wildlife zones, and important archeological and historic sites should be protected through formal designation by provincial agencies or through zoning by local authorities.

5.2.2 Discussion

Environmentally significant areas such as Yamnuska and East Canmore Flats should be designated as Natural Areas with restrictions on vehicle use and development.

Protection via Critical Wildlife Zoning in the Integrated Regional Plan or other mechanisms such as land use zoning controls in the M.D. of Bighorn should be afforded important wildlife habitat such as Lac des Arcs, Wind Ridge, Pigeon Mountain, Grotto Mountain, Chinaman Pits, Policeman Creek, Mt. Charles Stewart and Benchlands, Grotto Mountain, Exshaw Creek and Exshaw Mountain and Chilver Lake Wetlands. Developments should be excluded from these areas.

As additional sites are more clearly identified in the Environmentally Significant Areas studies and other surveys, zoning controls should be implemented to protect areas such as: bird of prey nesting areas, long-toed salamander ponds, diverse breeding bird areas, and ungulate movement corridors like those between Pigeon Mountain, Wind Ridge and Wind Mountain.

Storage of environmentally significant areas information in a computerized geographic information system would be helpful in measuring site-specific and cumulative impacts of proposed developments.

5.3 Mitigation of Biological Impacts

5.3.1 Principal Strategies

1. *Protect and interpret diverse and critical wildlife habitats, fish spawning streams, scarce habitat types and habitats for rare plants.*
2. *Conduct additional research into ungulate movements and rare plant habitats.*
3. *Strictly regulate construction and developments adjacent streams.*
4. *Concentrate developments in common habitat/vegetation types.*

5.3.2 Discussion

A. General

The Environmentally Significant Areas section identifies key wildlife, fisheries and rare plant habitats that should be protected through formal designation and zoning.

Tourism developments should be limited to more common habitat/vegetation types outside of environmentally significant areas such as major wildlife travel routes, wintering areas, mineral licks, rare species habitats, old-growth forests, grasslands, wetlands, and diverse breeding bird habitats. A variety of habitats and cover should be retained, even within developed areas.

Interpretation of several important sites and education of tourists, construction contractors, and local school students about the significant biological resources of the Corridor is required.

Where possible, previously disturbed sites should be used for development.

B. Wildlife

Trail development into critical wildlife habitats (e.g. calving areas, winter ranges, bird of prey nesting areas) should not be permitted or seasonal closures should be invoked to reduce harassment and other negative impacts.

Construction scheduling should take into account the seasonal importance of different habitats to the various species of wildlife.

New road development should be kept to a minimum and should not significantly affect principal ungulate travel corridors.

There is still a limited amount of baseline research on many of the wildlife resources. Nette and Jorgenson (1989) have put forward a proposal to define elk habits in the Corridor. Collection and storage of this and other wildlife information in a computerized geographic information system would be helpful in measuring site-specific and cumulative impacts of proposed developments.

C. Fisheries

In-stream construction activities, where needed, should be scheduled to avoid disruption of migration, spawning and egg incubation periods. Culverts and bridges must be designed to allow fish passage during all seasons.

D. Vegetation

There is still a limited amount of baseline research on vegetation and rare plants. A systematic survey of proposed development sites for rare plant populations is needed. Storage of this information in a computerized geographic information system would be helpful in measuring site-specific and cumulative impacts of proposed developments.

5.3.3 Other Strategies

A. General

Water extractions from groundwater sources should be kept at sufficiently great distances and low levels so as not to impact unique spring habitats, breeding ponds for long-toed salamanders, fish spawning streams and in-stream flow requirements. In-stream flow and groundwater standards should be established.

The use of chemical inputs in golf courses with relationship to various surficial materials needs to be reviewed to ensure that chemical contamination of fish habitats, springs and wetlands can be kept to a minimum.

B. Wildlife

Controlled burning, reclamation of disturbed areas and development of mineral licks to provide replacement habitat may provide the means for altering ungulate behavior and reducing some of the impacts of present and proposed developments.

Solid wastes should be disposed of in a manner that does not create human-bear conflicts. This may involve trucking of wastes to regional landfills or to Calgary as was done in Kananaskis Country (More 1986). Bear proof containers should be used at all tourism developments. A waste management plan should be instituted to help reduce, reuse and recycle solid wastes.

Hunting season closures may help cut down the harassment of species like elk (Geist 1970). This may become necessary as a temporary or permanent solution if it becomes evident that elk populations are continuing on a downward spiral.

Strictly enforced reduced speed limits may be necessary to reduce road kills along the Trans-Canada highway in the Corridor.

Helicopter activity should be restricted to flight paths and a limited number of non-environmentally sensitive sites.

C. Fisheries

Sewage should be treated in adequate facilities before being discharged into streams. This may involve the construction of new treatment plants or significant upgrading of existing facilities.

Hazardous materials should not be stored in floodplain areas.

D. Vegetation

Seasonal closures should be instituted to reduce problems along muddy trails during spring melt.

During construction and subsequent reclamation there should be careful attention paid to stripping, stockpiling and respreading of all organic and topsoil materials.

Rehabilitation/revegetation with native plant species is essential to maintaining ecosystem characteristics and preventing the spread of exotic plants. Revegetation must avoid the use of exotic species adaptable to south facing grasslands.

Debris burning should be scheduled for periods of low fire hazard and should strictly adhere to fire prevention rules. Adequate fire and fuel breaks should be placed around tourism developments.

McNeely and Thorsell (1987) show how vegetation carrying capacity can be increased through site hardening with surfacing materials for trails and through interpretive information and provision of viewing blinds and boardwalks.

5.4 Mitigation of Watershed Impacts

5.4.1 Principal Strategies

1. *Develop golf courses only on the most capable land systems and reduce chemical inputs.*
2. *Conduct additional research into the effects of golf courses.*
3. *Establish in-stream flow and groundwater standards.*
4. *Upgrade and develop sewage treatment facilities as required.*
5. *Site major tourism facilities outside of flood plains.*

5.4.2 Discussion

Due to the coarse nature of much of the surficial materials, none of the following land systems identified by O'Leary (1988) are considered ideal -- however, some are considered more capable for golf course development than others (Map 4). Ratings only apply to the relative physical capability to accommodate golf course developments. Several other land systems are physically suitable for accommodation and other tourism developments. Land systems not identified below are considered too steep, too sensitive or too rapidly drained to be suitable for golf courses. It should be remembered that there is a tremendous amount of site variability within these land systems and detailed technical studies would be required to confirm the capability of specific sites. A more detailed description of O'Leary's land classification is found in Appendix 4.

FR.M1 - highest physical capability for golf course development

- gently undulating to moderately inclined valley bottoms along the south side of the Bow River from Pigeon Mountain to Grassi Lakes
- thin loamy slopewash materials overlying gravelly sandy loam till
- variable stone content
- moderately well to well drained
- closed lodgepole pine and white spruce forests

FR.F1 - low to moderate physical capability for golf course development

- gently inclined alluvial fans along the bases of Pigeon Mountain and the Three Sisters
- gravelly sandy loam on upper slopes (low to no capability)
- thin clay loam veneers over sandy fluvial materials adjacent the Bow River (low to moderate capability)
- moderately well to well drained
- may be subject to periodic flooding
- white-spruce forests on upper slopes; lush aspen-dominated mixedwood on lower slopes

FR.F3 - lowest physical capability for golf course development

- nearly flat
- Bow River and Policeman Creek floodplain
- sandy to sandy loam materials
- well drained
- braided stream channel
- portions are subject to periodic flooding
- some important wildlife habitats occur within this unit

The use of chemical inputs in golf courses with relationship to various surficial materials needs to be thoroughly researched to ensure that chemical contamination of fish habitats, springs and wetlands can be kept to a minimum. Monitoring of ground and surface water for bacteriological

and chemical pollution should be a high priority for research. In the interim, chemical inputs should be kept to a minimum.

Sufficient water should be allocated to meet biological and other instream flow requirements. In-stream flow and groundwater standards for a variety of uses should be established.

The existing sewage plant should be upgraded as required and new plants constructed where wastes cannot be piped to facilities in Canmore. For remote locations and temporary housing, pump-out toilet systems should be used as in Kananaskis Country (More 1986).

Permanent and expensive structures should be located outside of major floodplains along the Bow River and alluvial fans along major tributary creeks.

5.4.3 Other Strategies

Adequate storm sewer facilities should be developed and maintained.

Riparian buffers of trees and shrubbery should be left along water courses.

Restrict use of salt on highways adjacent sensitive wetlands and chemical treatment for golf courses

Disposal of fluids from maintenance of construction vehicles should be done in an environmentally appropriate manner and hauled back to a proper disposal station.

5.5 Mitigation of Impacts on Cultural Resources

5.5.1 Principal Strategies

1. *Development of a comprehensive cultural resource management plan that includes strategies for protection and interpretation of important cultural resources.*
2. *Conduct additional research into the location and significance of cultural sites.*

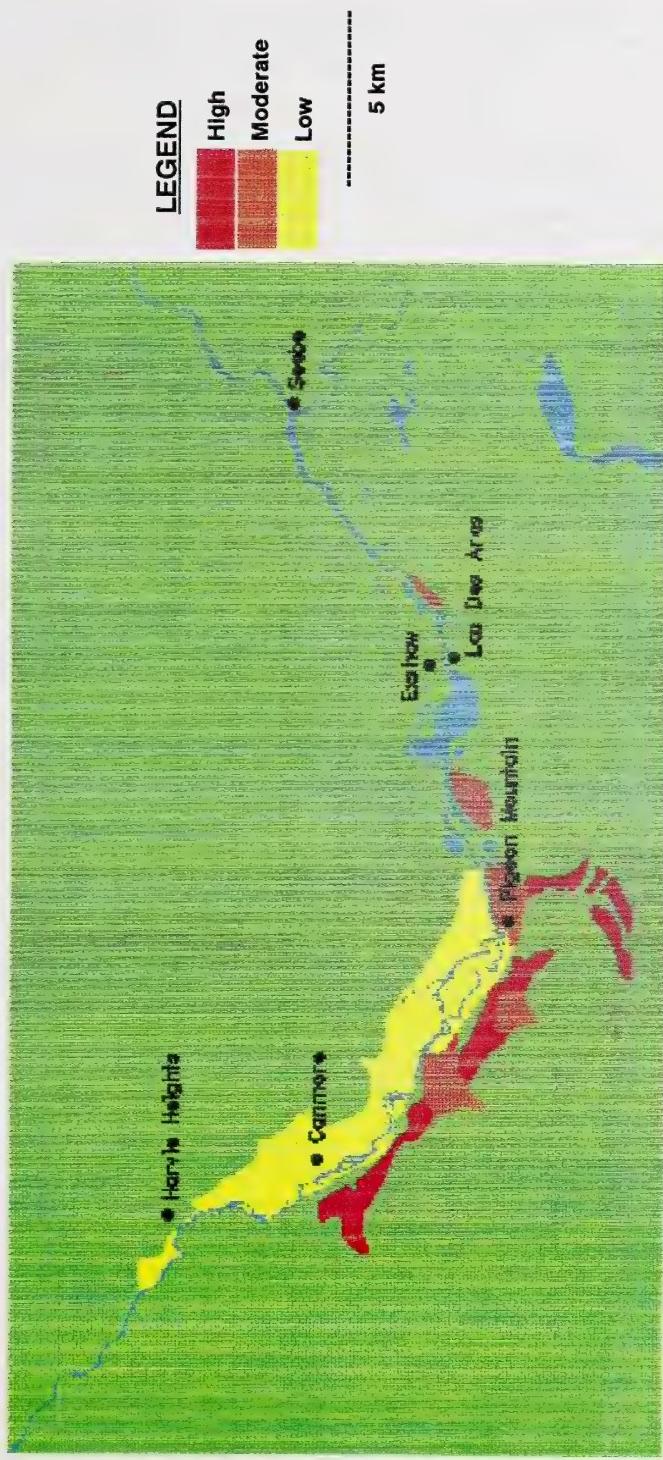
5.5.2 Discussion

While some constraints may exist because of site locations and existing or planned development, many of the Native sites are of such a nature that development can be mitigated through careful design and planning or conservation archaeological studies. Opportunities exist both through necessary mitigative studies as may be required as a result of developments, as well as through stabilization and development of key

BOW/CANMORE CORRIDOR

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- MAP 4: LAND SYSTEMS WITH GOLF COURSE DEVELOPMENT CAPABILITY -



sites, to interpret these sites to the visitor, thereby diversifying and enhancing recreational opportunities in the valley. Indeed some of the historic sites can best be managed and conserved through interpretive development.

The Bow/Canmore Corridor has a significant natural and cultural history. It is not all in Banff National Park. There are many interesting geological, biological and cultural aspects to the Corridor that could be developed through signage, as well as on site interpretive development.

To ensure that the more significant of these resources continue to exist on into the foreseeable future for the benefit of present and future generations and that their interpretive benefits are realized a comprehensive cultural resource management & interpretive plan for the Bow/Canmore Corridor is needed.

The first step in developing this management and interpretation plan is a comprehensive program of cultural resource inventory, mapping and subsurface assessment. This program would provide an in-depth data base for the Corridor, determine the range of sites present and their values. This data base can then be used by managers and planners to determine the impacts of specific developments on cultural sites and also cumulatively on the cultural resources of the Corridor as a whole. The use of a geographic information system would be a useful tool in this program.

A second component of the management plan is to ensure that Historical Resource Impact Assessments are undertaken, by the development proponents, for all private and governmental projects that will affect the land or the built environment before approvals are given at the municipal level. Further existing and ongoing resource extraction activities should be evaluated to determine if they are impacting cultural resources, and if they are, the necessary studies should be required.

The third component of the management plan will include ongoing mitigative and monitoring measures that are required to ensure the conservation of the resources in place and to mitigate against future impacts that can not be regulated through the development approval process.

Once inventory and assessment is complete, the interpretive component of the plan would be developed, through development of a master interpretive plan, that will develop appropriate interpretive themes and programs, and set out a sequenced phase of interpretive development.

5.5.3 Other Strategies

To mitigate against the eventual impacts to rock art, a detailed recording program should be done.

5.6 Mitigation of Terrain and Soil Impacts

5.6.1 Principal Strategies

Areas with high instability or erosion potential should be avoided for all types of tourism developments.

5.6.2 Discussion

Most land systems described by O'Leary (1988) in the Front Range (FR) C1 to 7, CR1 to CR2, GF1, R1 and X1 classifications (colluvial slopes, rock complexes, kame complexes) are too steep or rocky for any type of tourism development, except trails. While they may have limitations from wildlife or significant areas perspectives, land systems in the Front Range (FR) E, F, GF2 and M (fans, kame terrace and moraine) and Rosebud Plain (RP) classifications have considerable physical capability for a variety of tourism developments. Sites still require detailed geotechnical site investigations prior to development to determine the actual distribution of surficial materials.

Facilities should be set back from steep or unstable slopes and development discouraged on other sensitive lands (e.g. wetlands, springs, drainage channels and alluvial fans).

5.6.3 Other Strategies

Where use is intensive, site hardening (e.g. asphalt trails, boardwalks, and viewing platforms) may be needed along with passive barriers (e.g. railings) to direct flow of people movement (Landals 1986).

Significant geological features such as the hoodoos should be identified, protected and interpreted.

During construction and subsequent reclamation there should be careful attention paid to stripping, stockpiling and respreading of all organic and topsoil materials.

Developments should conform to the shape of natural landforms, avoiding large cuts and fills. Rock-cut texturing may help reduce visual impacts of cutbanks.

Where possible, new developments should take place in existing utility Corridors and other disturbed sites.

A restriction should be placed on further development of mineral resources in the area.

5.7 Mitigation of Other Problems

5.7.1 Principal Strategies

1. *Institute control strategies for fireplace emissions.*
2. *Coordinate planning and management agencies at municipal, provincial and federal levels.*
3. *Conduct baseline environmental research.*

5.7.2 Discussion

Control of fireplace emissions should be undertaken on the basis of adverse aesthetic, health effects and the probability of violating air pollution standards. Some localities have introduced laws limiting the use of wood stoves during times of heavy air pollution (Guenther 1987).

Several levels of government have responsibilities for managing environmental resources in the Corridor. There should be a formal mechanism (task force, working committee) established that would allow for a more coordinated approach to environmental protection.

There is still a very limited amount of data with respect to a number of environmental parameters. Baseline research would provide the data against which to measure future environmental impacts.

5.7.3 Other Strategies

Strategic placement of trails and information services are possibly the most useful methods of deliberately leading visitors away from sensitive areas (Cox 1980).

Water spraying to control dust will be useful during the construction phases.

Solid wastes should be disposed of in a manner that does not create environmental problems. This may involve trucking of wastes to regional landfills or to Calgary as was done in Kananaskis Country (More 1986).

6. CONCLUSION

There are significant natural and cultural resources in the Bow/Canmore Corridor and some areas of sensitive terrain. All of the proposed developments will impact on the resources of the Corridor to some degree.

Some of these impacts are mitigatable and some are not. For others, there is insufficient research data to demonstrate how successful mitigation could be.

In descending order of importance, the major issues related to proposed tourism developments in the Bow/Canmore Corridor are:

1. *Loss or Disruption of Wildlife and Fisheries Habitats, Cultural Resources, and Environmentally Significant Areas*
2. *Loss of Water Quality and Quantity*
3. *Inappropriate Flood Plain Developments*
4. *Impacts on Terrain and Soil*
5. *Loss of Air Quality*
6. *Land Use Conflicts*
7. *Aesthetic Impacts*

Major potential mitigation strategies include:

1. *Identify, protect and interpret environmentally significant areas and important cultural resources.*
2. *Screen all projects for potential impacts and conduct formal Environmental Impact Assessments for major developments (or groups or classes of developments) prior to development.*
3. *Adhere to specific guidelines for protecting the environment outlined in plans of the M.D. of Bighorn.*
4. *Conduct additional environmental research.*
5. *Develop facilities in the most capable and least sensitive land systems.*
6. *Refine environmental standards.*
7. *Upgrade and develop sewage treatment facilities as required.*

8. *Coordinate planning and management agencies at municipal, provincial and federal levels.*

The major issues that appear difficult to resolve or where research data is insufficient include:

1. *the impact of tourism developments on critical wildlife migration corridors and ranges.*
2. *the impact of golf courses on water quality.*

Other issues have a high probability for successful mitigation through education and traditional and innovative land and water use controls.

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APPENDIX 1: TOURISM AND THE ENVIRONMENT -- AN OVERVIEW

Introduction

Some researchers believe that, in the long run, tourism contributes to environmental destruction (Cohen 1978) while others believe that, with proper planning and management, tourism can enhance the environment (Pigram 1983). The evidence is far from clear and there remains the question of whether we protect the environment for tourism or protect it from tourism.

Conflicts between recreation users are likely to rise with increasing numbers of tourists (Jackson and Schinkel 1981). Sewell (1974) identified several different perceptions of the problem: conservationists see the countryside as the last bastion in the maintenance of biological diversity; outdoor recreationists view the continual expansion of development in the countryside with alarm; the developers think that modification is inevitable; and local authorities, despite the calls of various pressure groups for radical shifts in environmental thinking, indicate that there are no major problems.

Budowski (1977) believes that the relationship between tourism and conservation is usually one of coexistence moving toward conflict, mainly because of an increase in tourism and the shrinking of natural areas. Prentice (1989) suggests that to not consider the environmental consequences of tourism developments is at its worst to destroy the very resource that many tourists and others seek to enjoy.

Tourism and protection of the resource base should be more alike than contradictory (Gunn 1972). The very appeal that lures tourists to the Bow/Canmore Corridor could be eroded -- the reduced satisfaction resulting in unsustainable development that is out of step with community values. Murphy (1986) suggests that tourism and conservation could be more effective partners.

Becker (1980) notes that tourists do not generally bring an understanding of or an interest in coping with fragile environments. Both private and public sectors do not reckon with limited carrying capacities -- in fact, they arrange subsidies that promote short-term profits and growth but actions that create long-term environmental damage (de Groot 1983; Lundgren 1979). A lack of appropriate research and data on carrying capacity is evident. Development constraints and carrying capacity targets will need to be introduced to safeguard the long-term viability of the industry (Romeril 1989b; Rogalewski 1978; Messerli and Messerli 1979).

While there has been widespread acceptance of tourism as a complement to conservation programs, Romeril (1989a) and Pearce (1985) indicate that there has been a change in the pattern of recent publications that reflects the wider and growing awareness, interest and concern of current problems. These range from purely scientific concern for flora and fauna

to real risk of loss of human life. More recently the concern has been for recognition of a mutual dependence or symbiosis between tourism and the natural resources it relies on.

General Impacts of Tourism on the Environment

While tourism has much unrealized potential for environmental protection, negative impacts do occur. The most significant impacts are likely to be in natural environments but man-made environments may also be impaired.

Tourist activities often involve landscape and habitat change, the elimination of wildlife, soil compaction and erosion (Manning 1979). Certain wildlife species such as bears may need to be removed or shot when they become nuisances or dangerous. Human use of campgrounds and trails has compacted soil and altered vegetation cover. Most of the conflict occurs in valley bottoms where facilities are located; however, as more adventurous tourists penetrate the uplands and less accessible areas, even these sanctuaries disappear. Volz (1986) and Weiss (1987) indicate that tourism damage to the environment, including important changes to vegetation cover, has been widespread in the Swiss Alps.

Edington and Edington (1986) note the principal environmental effects of tourism as those related to road development and waste disposal. Elmore and Dahl (1980) suggest that rapid tourism growth has been partly responsible for elimination of environmentally significant areas in Colorado and has forced development into precious stream environment zones, creating flood hazards. On the other hand, Boo (1990) states that there have been few major environmental impacts from tourism in Latin American National Parks to date. Common environmental impacts included water pollution, litter, changes in animal behavior, and trail erosion. Vandalism, increased fires, poaching and feeding of wildlife were also reported problems.

Hallet et al (1981) and Iverson et al (1981) indicate a variety of problems associated with off-highway vehicle use, including an increase in the amount and frequency of runoff and sheet-wash erosion due to decreases in soil porosity and infiltration capacity. The effects tend to be long-lived. Moore et al (1978) indicate somewhat higher levels of heavy metals in snow in a ski resort from automobile exhaust pollution.

Air Quality Impacts of Tourism Developments

The trend towards increased fireplace use is causing concern as toxicity assays performed on residential wood combustion samples consistently indicate that highly toxic, carcinogenic and mutagenic fractions are present (Galasyn 1985; Houck et al 1989; Khesina et al 1989; Moeller et al 1985; Quraishi 1985; Ramdahl et al 1984; Rau 1989; and Romero et al 1978). Residential wood combustion emissions are an important source of organic and elemental carbon particulate matter in many urban and suburban areas and they can cause considerable air pollution (Quraishi 1985; Moeller et al 1985; and Ramdahl et al 1984).

Particularly heavy use of fireplaces resulting in the exceedance of carbon monoxide standards has occurred during holiday periods in Texas (McMullen and Evans 1988). In the ski resort of Vail, Colorado, Romero et al (1978) showed that state standards were violated more frequently than state data indicated. Several environmental agencies around the world are now quantifying and characterizing emissions in aid of potential regulation (Quraishi 1985; Core et al 1984).

There is also likely to be some deterioration in air quality due to increased motor vehicle access to major tourism developments; however, there is no literature available to indicate the magnitude of these impacts.

Water Quality Impacts of Tourism Developments

The Sunshine Village resort has had continuing problems with its sewage treatment and has released untreated effluent into local streams (Canadian Parks Service 1989).

Thomson (1983) and Haulot et al (1977) note cases where tourism developments would have increased pollution and, in one case, threatened the water supply for Winnipeg. The city insisted that the Federal Environmental Assessment Review Office conduct a study.

There is increasing concern over the impact of golf course chemicals on water supplies. Apparently, there are environmental groups in Japan that have been established specifically to oppose golf course developments (V. Geist, pers. comm.). While not directly related to tourism, other studies show alarmingly fast downward movement of nitrate under irrigation in porous soils in the Nebraska sand hills of around two metres per year. Even where management is good there is a loss of 30 to 50 pounds of nitrogen per acre per year (Nebraska Water Resources Centre 1984).

Involvement of and Impacts on Local Communities

Feurstein (1977), Ramprasad et al (1987) and Murrell (1984) suggest that the role of local operators be strengthened; that the needs of the local population should always be considered; that advertising should not provide distorted images of destinations; and that more tourism research centres are needed. Fast growth rates of tourism resulted in lack of integration with the local population and upset the balance of the ecosystem. Liu et al (1986) and Hong (1985) describe the negative social impacts of tourism.

Murphy (1985) describes the problem of the city of Gatlinburg where restrictions on overnight accommodation in the Great Smoky Mountains National Park have turned the city into a planner's nightmare. Cheng (1980) notes that with the strict limits placed on Banff's growth, the result could be another Gatlinburg with all its attendant social problems. There have been instances where governments, in their zeal to

attract more tourists, are often ready to disregard zoning regulations and other standards (Gonen 1981).

Vassallo et al (1980) indicate that tourism can destroy tourism if a region's popularity causes overcrowding and environmental degradation. Swiss experts in tourism and planning see tourism as an industry with an inherent tendency to overdevelop and become self-destructive, and also destructive of the local community if not firmly controlled. Much depends on the earliest decisions. It is not easy to reverse effects of these decisions, especially if the wrong scale or rate of development is established. Planning becomes developer-led and out of balance with environmental and social concerns.

Positive Contributions of Tourism on the Environment

While there are many examples of poorly designed tourism developments, the built environment for today's tourist can combine quality architecture and engineering with higher standards of safety, sanitation and maintenance to reduce pollution. Tourism need not destroy all natural and cultural values and can contribute an aesthetically pleasing landscape. In order to accomplish this, considerable research and commitment to careful planning and management are required.

There are a few examples where tourism development is being done in an atmosphere of rigid environmental controls. The Farnborough tourism resort project in Australia calls for the elimination of private motor vehicle traffic in favour of walkways and public transport; preservation of wetlands and other physical and biological features; blending of man-made and natural environments; boardwalks through fragile environments; and a management and drainage divide to contain effluent and wastes (Pigram 1980; 1983).

Greater understanding of natural and cultural environments and economic justification for the improved protection and management of fish, wildlife and cultural resources from "ecotourism" can be positive benefits (Boo 1990).

The Future

Increasing concern has come from more discriminating tourists and greater awareness of tourism's impact on the physical and aesthetic environment. In the future, greater emphasis is likely to be placed on issues of better environmental design and land use for tourism (Gunn 1987). The World Bank recognizes the need for additional wildlands in economic development through tourism (Ledec and Goodland 1988)

Conclusion

Murphy (1985) stresses that the biggest concern for tourist destination communities should be the conservation of the natural tourism resources. The supply of protected areas has not kept pace with tourism growth.

Tourist development has maximum benefits and minimum detractions within a framework of provincial priorities and policies, where local people are in charge of tourism business and where the local community as a whole is able to decide on controls and restrictions (Boo 1990). The Swiss studies indicate the merits of tourist development proceeding in small steps and restrictions being placed on housing for non-residents (Watson and Watson 1982).

APPENDIX 2: REDUCING THE IMPACT OF TOURISM -- A LITERATURE REVIEW**Overall Strategies**

Rosier et al (1986) and Kozlowski et al (1988) developed a method (Ultimate Environmental Threshold) to identify areas, development levels and time periods to which various forms of tourism should be confined. Tangi (1977) and Travis (1983) also propose strategies to deal with environmental problems related to tourism development.

The World Tourism Organization (1981) has organized an environment committee to help develop policies to prevent damage through misuse of natural and cultural resources.

Landals (1986) describes several ways of reducing tourism's impact on the environment including:

1. increasing the level of resource protection;
2. zoning for different uses or non-use;
3. site hardening;
4. better design and location of facilities;
5. dispersing and regulating numbers of visitors;
6. temporary closures on access;
7. regular monitoring and maintenance; and
8. education of tourists and facility and parks' personnel.

Site Protection

Wight (1988), Lundgren (1979) and Murphy (1985) suggest that more effective management and additional protected areas are required. Lands must be zoned to balance the twin mandates of preserving natural features and providing visitor access. Strict controls, with possible permitting, may be needed in the most restrictive zoning categories. The authors note that there is always a danger that zoning will become the planning goal rather than a tool to facilitate achievement of objectives.

Environmental Assessment

Jackson (1984) describes the need for impact analysis and monitoring of the tourism-related environment. Environmental assessments have been standard procedure in the United States since the early 1970's. Both large and small developments, including motels, have been evaluated.

More (1986) suggests that the preparation of environmental design standards guidelines and preparation of environmental assessments and mitigation strategies suited to the level of development have been of considerable importance in maintaining environmental quality in Kananaskis Country.

Stankey et al (1986) outline a method of evaluation called the "limits of acceptable change" that recognizes that there will be some impairment because of human use but, while it may be of a long-term nature, that type of impairment should be localized. While their evaluation applies to wilderness, it could be adapted for tourism in the Canmore Corridor and may be useful in defining strictly protected areas (no development) and various levels of compromise areas (development in relative harmony with natural surroundings at different levels of intensity).

MacPherson Consultants (1982) and Schaenman (1976) provide some guidelines for planning and evaluating developments with respect to waste disposal, topographic slope instability, surficial drainage, and sensitive environments. The checklist of features to be assessed includes: physical degradation potential including erosional potential and slope instability; environmentally sensitive sites including migration sites, endangered species habitats, denning areas, spawning sites, wildlife management areas, geological features, archeological sites; floodprone areas; competing land uses; sewage treatment plants; availability of infill land; water quality concerns; and amount of grass cover.

Research and Monitoring

Vassallo et al (1980) conclude that vigilance and monitoring is needed because of the rapid pace of tourism development. Dragicevic (1989) indicates a need to expand scientific research that would enable a better assessment of the effects of tourism on the environment, to improve the store of information required for research and policy making, and to develop effective methods of controlling ecological damage and protecting the environment. In particular, sensitive sites should be monitored to ensure tourists comply with guidelines. Periodic environmental audits should be conducted to ensure the region profits from tourism (Boo 1990). Early detection of problems is important in ensuring that no irreversible damage takes place.

Several authors indicate the need to have good baseline data in order to effectively monitor changes into the future. Schaenman (1976) provides several parameters that should be monitored, and criteria by which they can be assessed:

1. Air Quality - monitor changes in concentrations of pollutants and assess against baseline concentrations and water quality standards
2. Water Quality - monitor changes in concentrations of pollutants and assess against baseline concentrations and water quality standards

3. Wildlife and Vegetation - measure changing wildlife populations and abundance (common and rare species) against baseline inventory data

Carrying Capacity

Stankey (1981), Boo (1990), Jackman (1988), Henry (1988), and Wight (1988) feel it is important to establish carrying capacity parameters to achieve a desirable set of ecological and social conditions with respect to tourism developments. Carrying capacity has been defined as the estimated level of use an area can sustain while maintaining a high level of visitor satisfaction and few negative environmental impacts.

Ecological carrying capacity has been reached when changes occur in animal behavior (outmigration, reductions in populations, change in nesting patterns) or when there is surface erosion.

Carrying capacity knowledge can guide zoning and redistribute visitors in space and time. Williams (1987) identifies a means for evaluating physical carrying capacity.

Education and Interpretation

Boo (1990), Wodzicki (1981) and Wight (1988) propose environmental education and interpretation as a means of solving problems related to tourism impacts. To manage sites for tourism, there is a need for ongoing education in local schools and training programs for personnel on environmental and tourism management. Tour operators and the private sector should actively participate in environmental education and become more involved in conservation of sites.

Kuchar (1972a and b) and Cook and Wells (1985) suggest that tourists should be deflected from overcrowded places through signage and interpretive brochures.

Mertens (1989) argues that many problems could be reduced considerably if tourists were encouraged to modify their behaviour. Suggestions made include changing the times of holiday departures to alleviate overcrowding during peak seasons; encouraging the increased use of public transport in preference to cars to reduce levels of pollution; choosing less popular and less crowded destinations to avoid placing unnecessary strain on an already overused infrastructure; staying in hotels or guest houses rather than renting villas or other self catering accommodation in order to provide employment for the local population; and respecting the local culture of the population.

Involvement of Local Conservation Organizations and Communities

Machlis and Tichnell (1985) and Boo (1990) indicate the need to involve local conservation organizations and communities and to improve their access to the scientific data relevant to threats. Tour companies can also be useful allies. It is interesting to note that smaller, locally-based tour companies often make the largest donations to conservation programs and groups.

Road Construction

U.S. National Parks Service (1989) and Public Works Canada (1981) provide detailed information on mitigating environmental damage from highway construction. These include importing borrow materials from outside protected areas; removal of all merchantable timbers and immediate disposal; chipping of removed vegetation for mulch for revegetation; on-site inspector to monitor all ground disturbing activities to ensure activities meet defined standards; clear delineation of construction areas and requirement for contractors to work within limits; protection of soils from erosion by revegetation with native species; contouring of ditches and matting; and silt fences along gentle fill slopes to allow water to percolate through.

A revegetation plan prescribes revegetation treatment for each identified land type. Areas with high erosion potential have highest priority for revegetation or should not be developed in the first place. Additional topsoil may be brought in as needed. Procedures are described to limit slumping of material into waterways when working around streams.

Development Capability of Surficial Materials

MacPherson Consultants (1982) indicate that glaciofluvial sands and gravels, shales, colluvial deposits, bedrock outcrops, organic deposits, and aeolian deposits are generally considered unsuitable for most developments. Glacial till and alluvial and glaciolacustrine deposits are considered the most suitable. Soils are best if they contain a mixture of fine and coarse materials.

Other Notes

Green and Marshall (1987) note that golf courses are more effective at protecting rare species and relict landscapes provided there are sizeable areas of less intensively managed rough. Fairways and greens that are commonly managed on agronomic principles have greater environmental impact than benefits. Some clubs in the U.K. are aware of the wildlife and landscape value of their courses and manage them accordingly.

Murphy (1985) notes that public transit can be a useful way of reducing environmental problems associated with private cars.

Properly managed, wastewater from tourist developments need not be a problem (White et al 1978).

Mendes et al (1988) bring forward the idea of fees to help pay for management required offset environmental losses.

APPENDIX 3: NATIONAL AUDUBON SOCIETY'S TOURISM CODE OF CONDUCT

In response to the increasing interest in ecotourism and the potential for environmental damage, the National Audubon Society released a tourism code of conduct which states that:

1. Biotas shall not be disturbed.
2. Tourism to natural areas will be "Resource Sustainable".
3. Sensibilities of other cultures shall be respected.
4. Waste disposal shall have neither environmental or aesthetic impacts.
5. Tourist should enrich his or her appreciation of nature, conservation and the environment.
6. The effect should be to strengthen conservation efforts and enhance the natural integrity of tourist areas.
7. Traffic in products that threaten wildlife and plant populations shall not occur.

APPENDIX 4: O'LEARY'S LAND CLASSIFICATION SYSTEM

O'Leary (1988) prepared an Integrated Resource Inventory and Evaluation of the Bow Corridor Integrated Resource Planning Area. He stratified the study area into two major physiographic subregions: the Front Range of the Rocky Mountains and the Rosebud Plain of the Western Alberta Plains and subdivided these into a number of land systems or ecosites.

For each of the different land systems or ecosites within these physiographic subregions, he developed capability ratings for fall/winter ungulate habitat (elk, moose, mule deer, sheep) and facility siting (primitive camping, fully serviced campgrounds, picnic areas, paths, trails, permanent buildings with or without basements, septic tanks, trench-type landfills, road location, sources of roadfill, and sources of sand and gravel).

Several units were unacceptable (e.g. steep colluvial slopes and rock complexes) for most kinds of tourist facility development. A few (e.g. fluvial fans, moraines, glaciofluvial terraces and benchlands) displayed low to high capability for a variety of developments. Golf courses were not rated and a rating developed for this study has been included in Section 5.4.2 of this report.

For moose, the most capable units were areas of willow thickets and sedge meadows interspersed with mixedwood and coniferous stands. The units with the highest potential for mule deer included diverse habitats on south-facing slopes or reclaimed areas. The most capable bighorn sheep winter ranges occur on diverse habitats on south-facing slopes. The highest potential for elk occurred in grassy lodgepole pine woodlands and grassland communities.

Goss and Marshall (1987) note that golf courses are more effective at protecting rare species and certain landscapes provided there are sufficient areas of less intensively managed areas. Fairways and greens that are carefully managed by professional practitioners have created environments better than before. Some sites in the U.S. are aware of the wildlife and heritage value of their courses and manage them accordingly.

Murphy (1988) notes that public transit can be a useful way of reducing environmental problems associated with private cars.

Properly managed wastewater from tourist developments may not be a problem (White et al. 1978).

McNamee et al. (1988) bring forward the idea of fees to help pay for enhancement required after environmental damage.

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